- Specifications

Fuel Tank Pressure Sensor (FTPS)

▷ Type : Piezo-Resistive Pressure Sensor

▷ Specification

Pressure [kPa (kgf/cm², in H2O)]	Output Voltage (V)
-6.67 (-0.068, -26.8)	0.5
0	2.5
+6.67 (+0.068, +26.8)	4.5

Canister Close Valve (CCV)

▷ Specification

Item	Specification
Coil Resistance (Ω)	19.8 - 21.8 [20°C (68°F)]

- Tightening Torques

Item	kgf.m	N.m	lb-ft
Positive crankcase ventilation valve	0.8 - 1.2	7.8 - 11.8	5.8 - 8.7

- Description

Emissions Control System consists of three major systems.

- The Crankcase Emission Control System prevents blow-by gas from releasing into the atmosphere. This system recycles gas back into the intake manifold (Closed Crankcase Ventilation Type).
- The Evaporative Emission Control System prevents evaporative gas from releasing into the atmosphere. This system burns gas at appropriate engine operating condition after gathering it in the canister.
- The Exhaust Emission Control System converts the three pollutants [hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx)] into harmless substances by using the 3-way catalytic converter.

- Troubleshooting

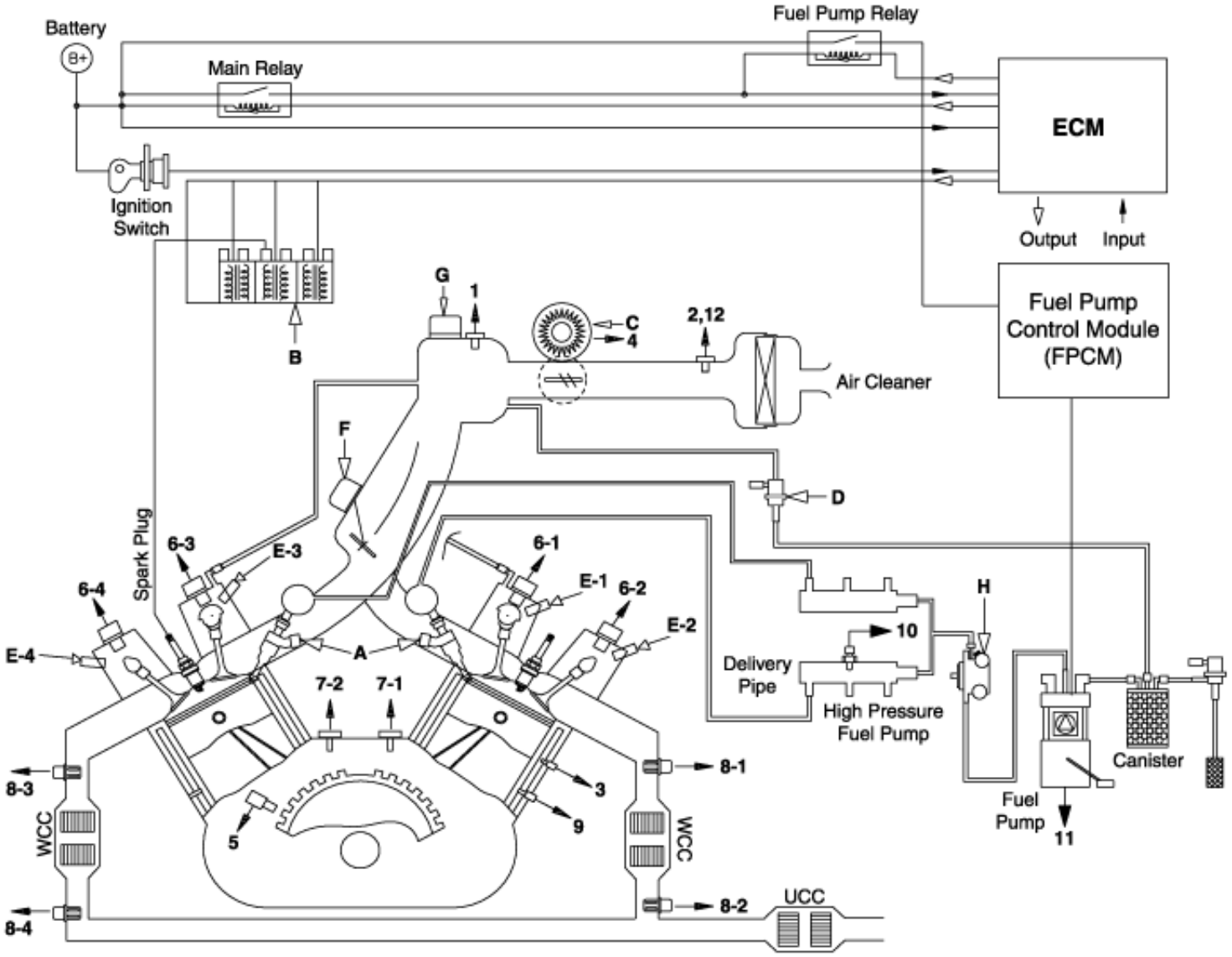
Symptom	Suspected area
Engine does not start or struggles to start	Vapor hose damaged or disconnected
Engine struggles to start	Malfunctioning Purge Control Solenoid Valve
Rough idle or engine stalls	Vapor hose damaged or disconnected
	Malfunctioning PCV valve
Rough idle	Malfunctioning Evaporative Emission Control System
Excessive oil consumption	Positive crankcase ventilation line clogged

- Schematic Diagram

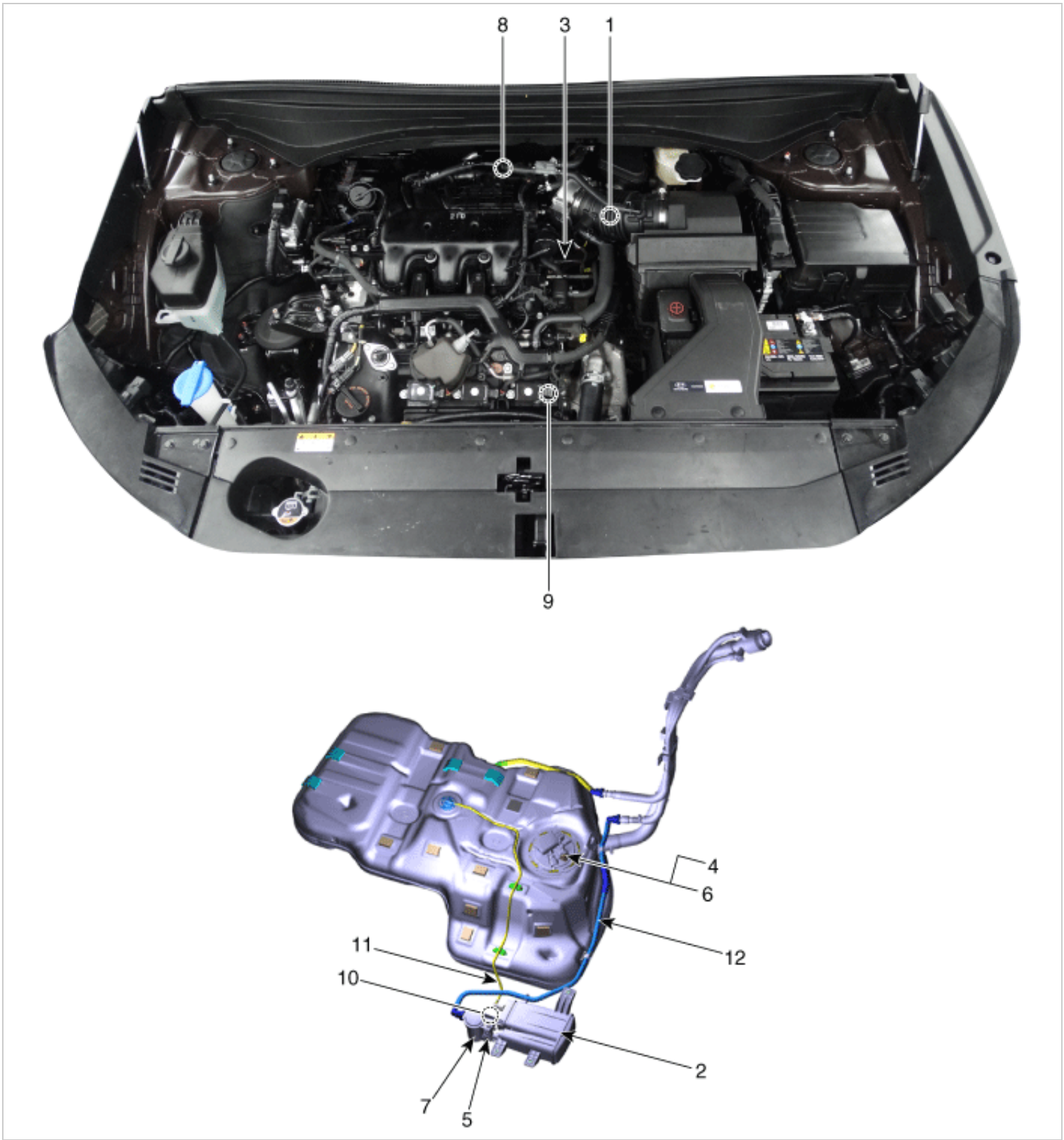
1. Manifold Absolute Pressure Sensor (MAPS)	· Spark switch signal
2. Intake Air Temperature (IATS)	· Battery power signal
3. Engine Coolant Temperature Sensor (ECTS)	· Speed signal
4. Throttle Position Sensor (TPS) [integrated into ETC Module]	· Cooling load signal
5. Crankshaft Position Sensor (CKPS)	· Inhibitor switch signal
6-1. Camshaft Position Sensor (CMPS) [Bank 1 / Intake]	
6-2. Camshaft Position Sensor (CMPS) [Bank 1 / Exhaust]	
6-3. Camshaft Position Sensor (CMPS) [Bank 2 / Intake]	
6-4. Camshaft Position Sensor (CMPS) [Bank 2 / Exhaust]	
7-1. Knock Sensor (KS) [Bank 1]	
7-2. Knock Sensor (KS) [Bank 2]	
8-1. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor1]	
8-1. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor2]	
8-1. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor1]	
8-1. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor2]	
9. CVVT Oil Temperature Sensor (OTS)	
10. Rail Pressure Sensor (RPS)	
11. Fuel Level Sensor (FLS)	
12. Barometric Pressure Sensor (BPS)	
· Accelerator Position Sensor (APS)	
· A/C Pressure Transducer (APT)	

ECM

A. Injector
B. Ignition Coil
C ETC Motor [integrated into ETC Module]
D. Purge Control Solenoid Valve (PCSV)
E-1. Variable Force Solenoid (VFS) [Back 1 / Intake]
E-2. CVVT Oil Control Valve (OCV) [Back 1 / Exhaust]
E-3. Variable Force Solenoid (VFS) [Back 2 / Intake]
E-4. CVVT Oil Control Valve (OCV) [Back 2 / Exhaust]
F. Variable Intake Solenoid Valve (VIS) valve 1
G. Variable Intake Solenoid Valve (VIS) valve 2
H. Fuel Pressure Control Valve [FPCV]
· Main Relay
· Fuel Pump Relay
· A/C Control signal
· Diagnosis



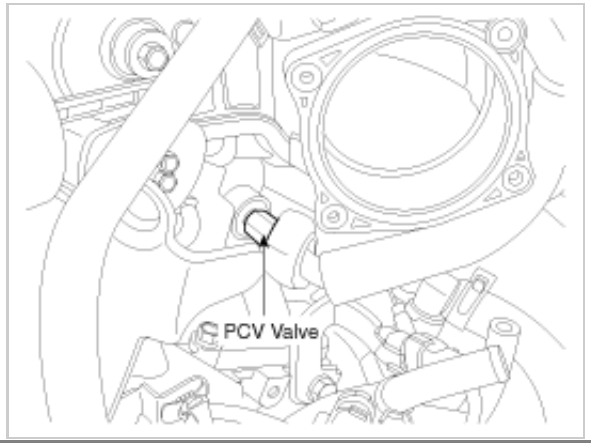
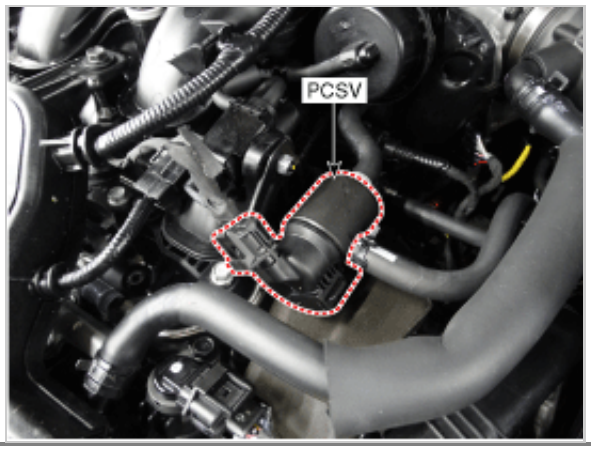
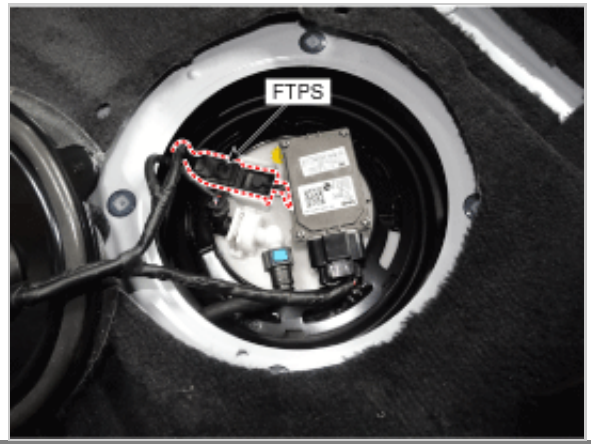
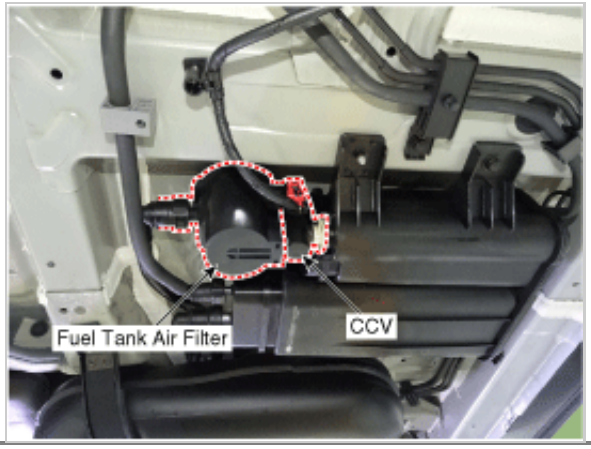
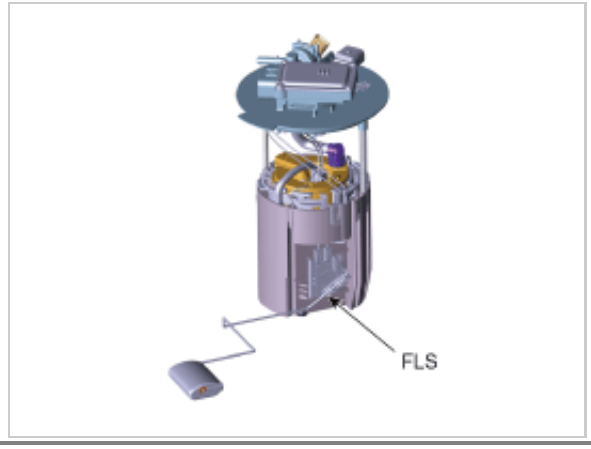
- Components Location

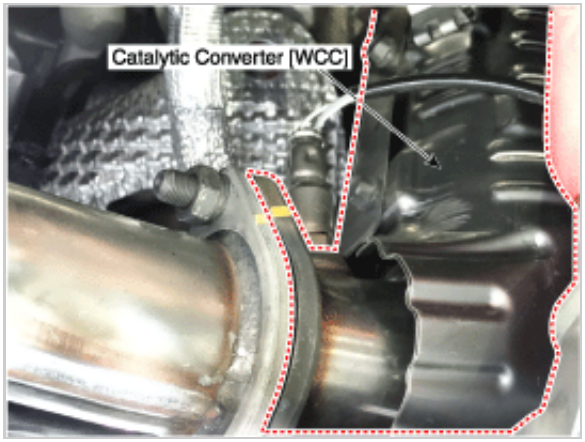


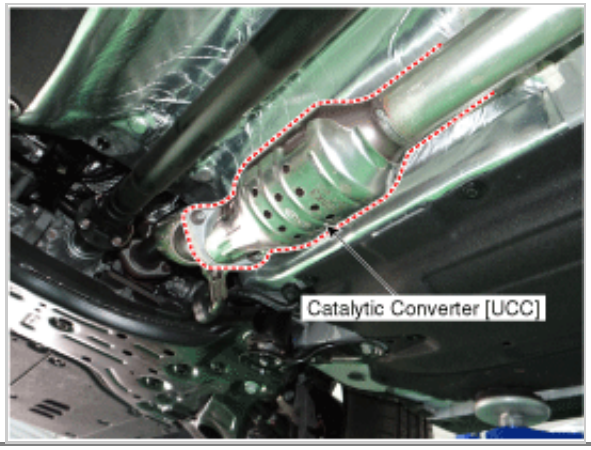
1. PCV Valve
2. Canister
3. Purge Control Solenoid Valve (PCSV)
4. Fuel Tank Pressure Sensor (FTPS)
5. Canister Close Valve (CCV)
7. Fuel Tank Air Filter
8. Catalytic Converter (WCC)
9. Catalytic Converter (UCC)
10. Vapor hose (Canister ↔ Intake Manifold)
11. Vapor hose (Canister ↔ Fuel Tank)

6. Fuel Level Sender (FLS)

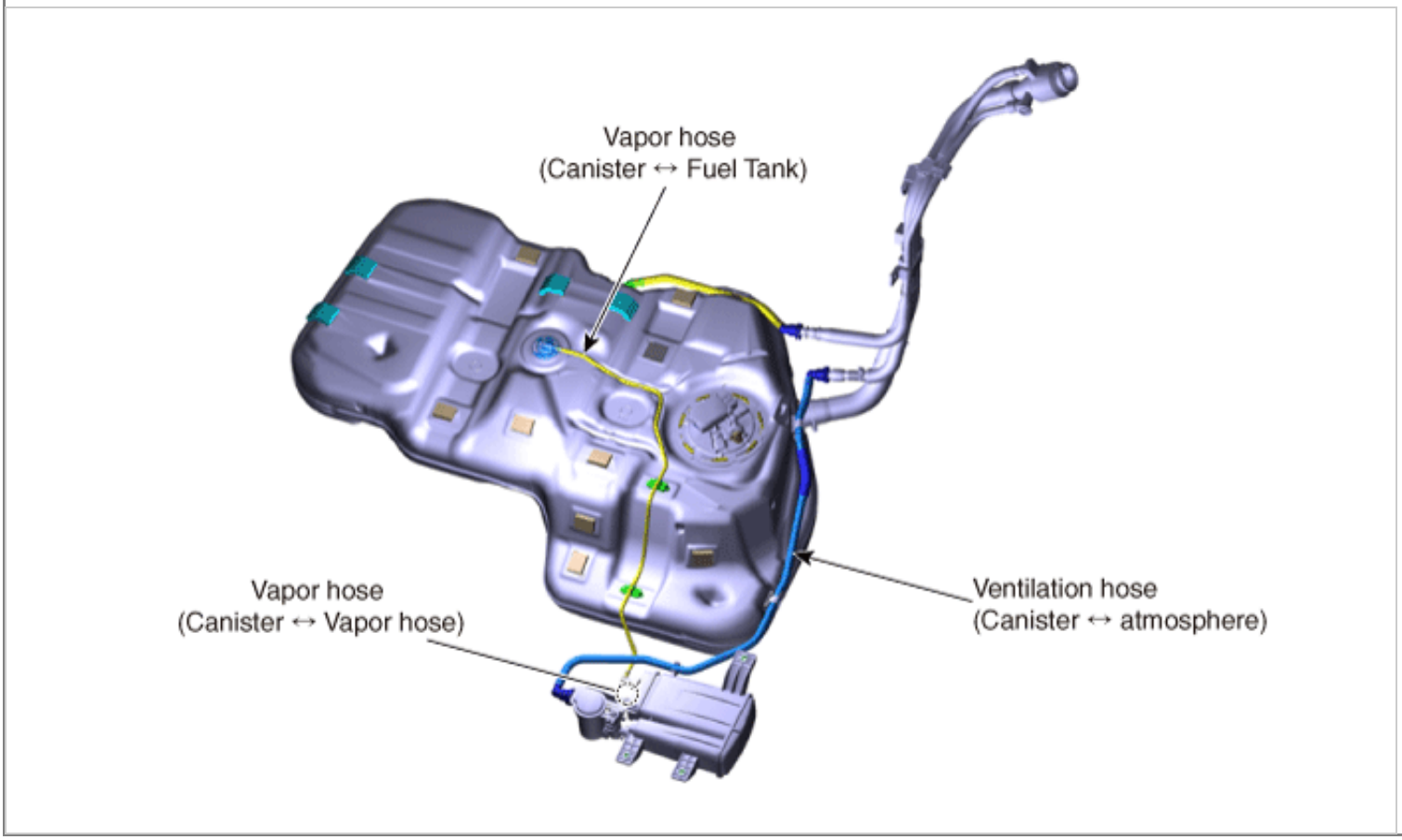
12. Ventilation hose (Canister ↔ atmosphere)

1. PCV Valve	2. Canister
	
3. Purge Control Solenoid Valve (PCSV)	4. Fuel Tank Pressure Sensor (FTPS)
	
5. Canister Close Valve (CCV) 7. Fuel Tank Air Filter	6. Fuel Level Sender (FLS)
	
8. Catalytic Converter (WCC)	9. Catalytic Converter (UCC)

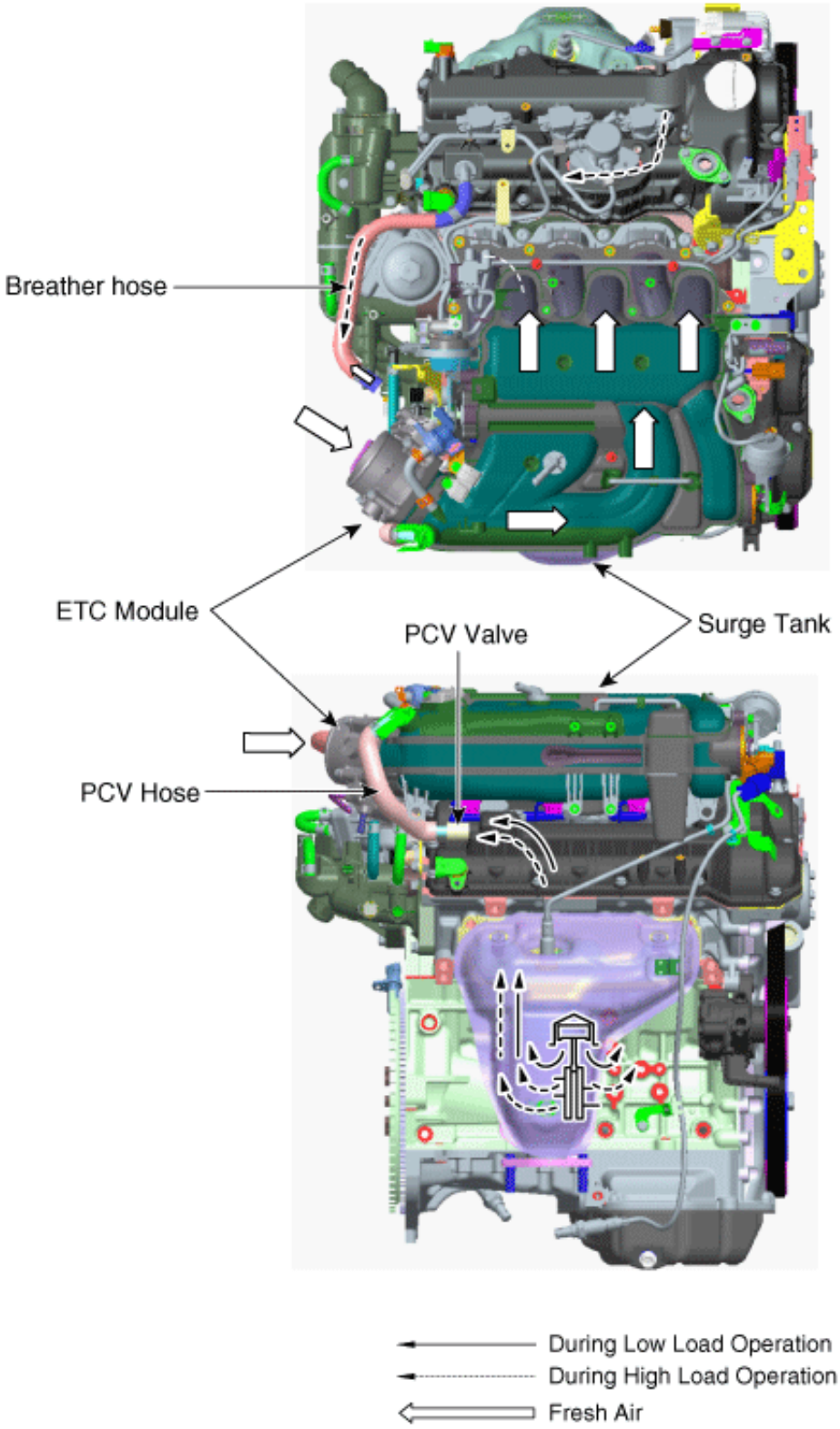




10. Vapor hose (Canister ↔ Intake Manifold)
11. Vapor hose (Canister ↔ Fuel Tank)
12. Ventilation hose (Canister ↔ atmosphere)



- Schematic Diagram



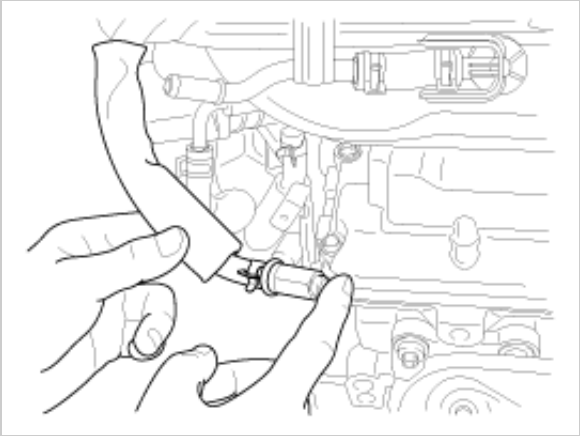
- Inspection

1. After disconnecting the vapor hose from the PCV valve, remove the PCV valve.

2. Reconnect the PCV valve to the vapor hose.
3. Run the engine at idle, then put a finger over the open end of the PCV valve and make sure that intake manifold vacuum can be felt.

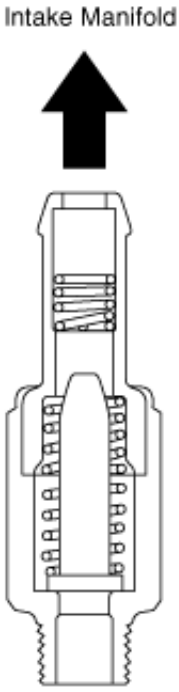
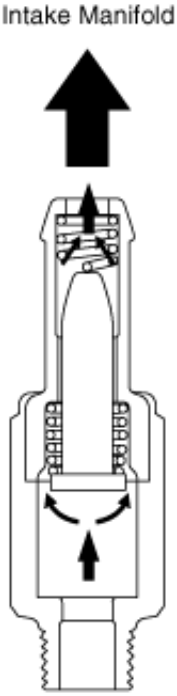
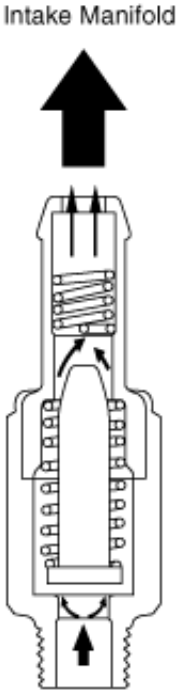
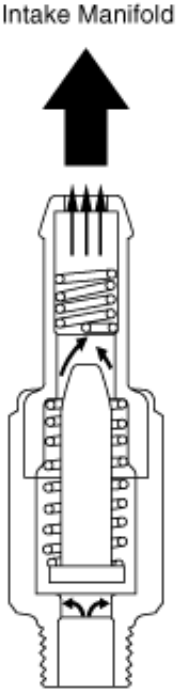
NOTICE

- The plunger inside the PCV valve will move back and forth in vacuum.



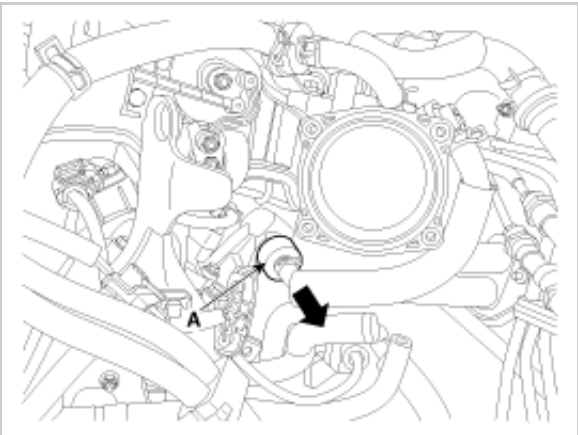
4. If vacuum is not felt, inspect PCV operation. If operating correctly, clean or replace the vapor hose.

- Operation Principle

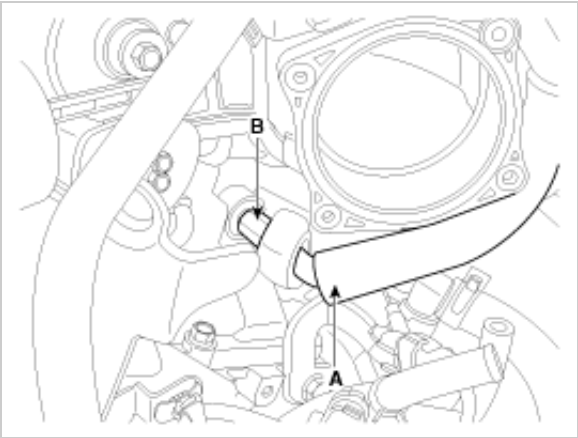
Engine Condition	Not Running	Idling or Decelerating	Normal Operation	Accelerating and High Load
Vacuum in Intake Manifold	0	High	Moderate	Low
PCV Valve	Close	Slightly Open	Properly Open	Fully Open
Blow-by Gas Flow	0	Small	Medium	Large
Schematic Diagram				

- Removal

1. Release the PCV pad.

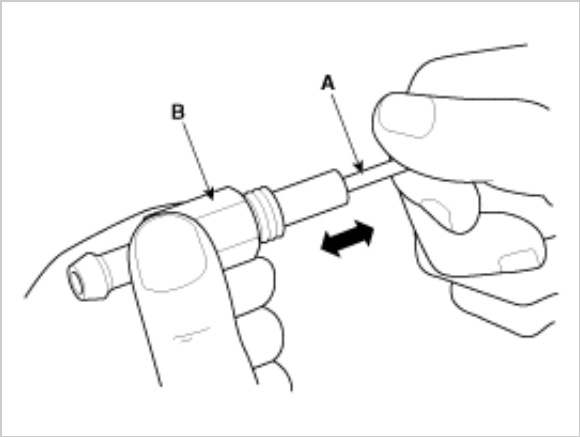


2. Disconnect the vapor hose (A).
3. Remove the PCV valve (B).



- Inspection

1. Insert a thin stick (A) into the PCV valve (B) from the threaded side to check for plunger movement.



NOTICE

- If the plunger does not move (PCV valve is clogged), clean or replace the valve.

- Installation

1. Install in the reverse order of removal.

PCV Valve :

7.8 - 11.8 N.m (0.8 - 1.2 kgf.m, 5.8 - 8.7 lb-ft)

NOTICE

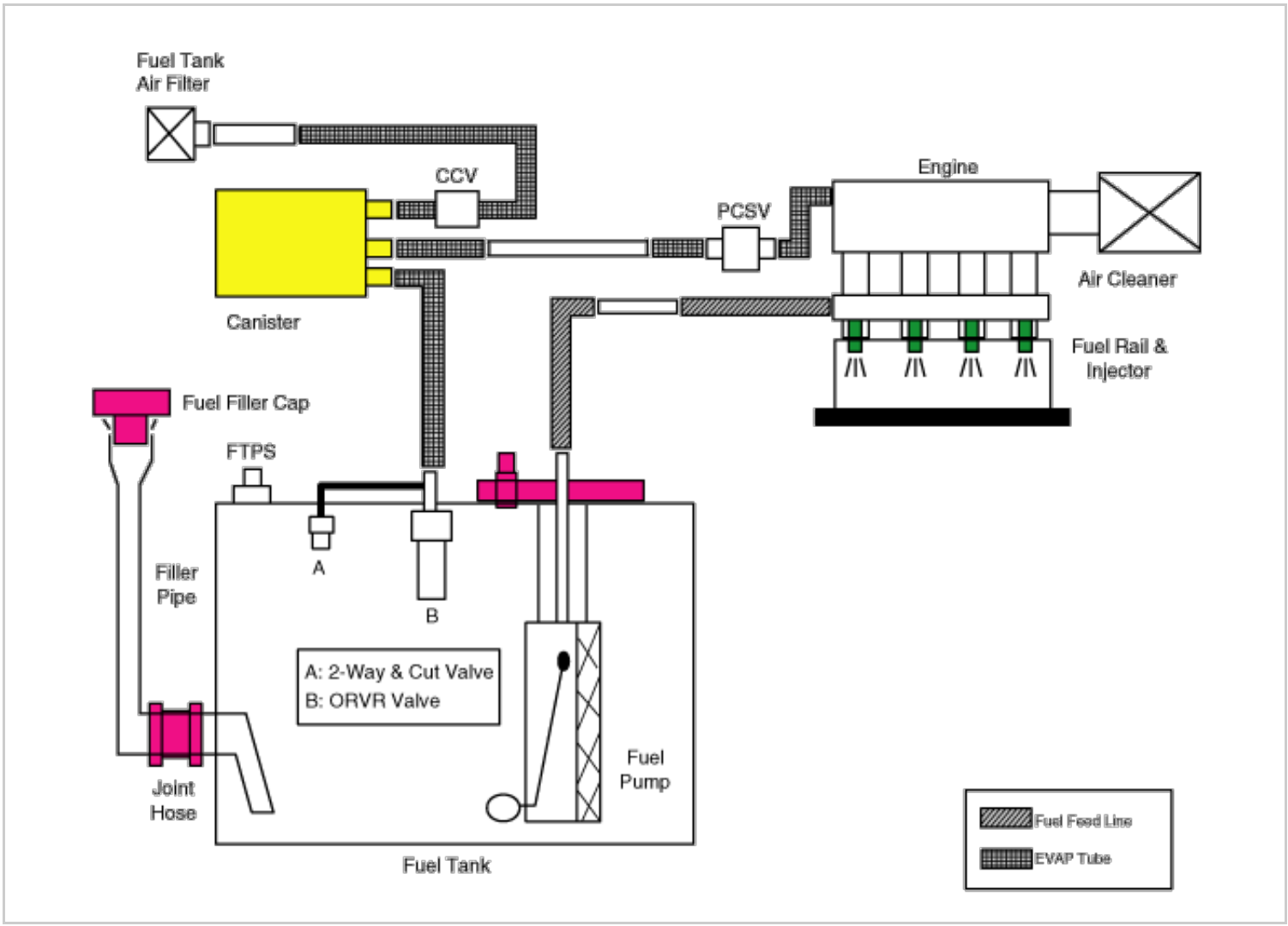
- Apply Loctite243 around the screw when installing the PCV valve

- Description

Evaporative Emission Control System prevents fuel vapor stored in fuel tank from vaporizing into the atmosphere. When the fuel evaporates from the fuel tank, the vapor passes through vent hoses or tubes into canister filled with charcoal and the canister temporarily holds the vapor in the charcoal.

If ECM determines to draw the gathered vapor into the combustion chambers at certain operating conditions, it will use vacuum in the intake manifold to move it.

- Schematic Diagram



Canister

Canister is filled with charcoal and absorbs evaporated vapor in fuel tank. The gathered fuel vapor in canister is drawn into the intake manifold by the ECM/PCM when appropriate conditions are set.

Purge Control Solenoid Valve (PCSV)

Purge Control Solenoid Valve (PCSV) is installed in the passage connecting canister and intake manifold. It is a heavy duty type solenoid valve operated by ECM/PCM signal.

To draw the absorbed vapor into the intake manifold, the ECM/PCM will open the PCSV, otherwise the passage remains closed.

Fuel Filler Cap

A ratchet tightening device on the threaded fuel filler cap reduces the chances of incorrect installation, and seals the fuel filler. After the gasket on the fuel filler cap and the fill neck flange make contact, the ratchet produces a loud clicking noise indicating the seal has been set.

Fuel Tank Pressure Sensor (FTPS)

The Fuel Tank Pressure Sensor (FTPS) is an integral part of the monitoring system. The FTPS checks Purge Control Solenoid Valve (PCSV) operation and leaks in the Evaporative Emission Control System by monitoring pressure and vacuum level in the fuel tank during PCSV operating cycles.

Canister Close Valve (CCV)

The Canister Close Valve (CCV) is located between the canister and the fuel tank air filter. It closes off the air inlet to the canister for the Evaporative Emissions System and also prevents fuel vapors from escaping from the Canister when the vehicle is not operating.

Evaporative System Monitoring

Evaporative Emission Control Monitoring System consists of fuel vapor generation, evacuation, and leakage check step. At first, the OBD-II system checks if vapor generation due to fuel temperature is small enough to start monitoring. Then it evacuates the evaporative system by means of PCSV with ramp in order to maintain a certain vacuum level. The final step is to check if there is vacuum loss by any leakage of the system.

Vapor Generation Checking

During stabilization period, the PCSV and the CCV are closed. The system pressure is measured as starting pressure (DP_A). After a certain defined period (T1), the system pressure (DP_B) is measured again and the difference from the starting pressure is calculated. If this difference (DP_B - DP_A) is bigger than a threshold, there should be excessive vapor and the monitor is aborted for next checking. On the contrary, if the difference is lower than another negative threshold, PCSV is regarded as malfunction such as clogged at open position.

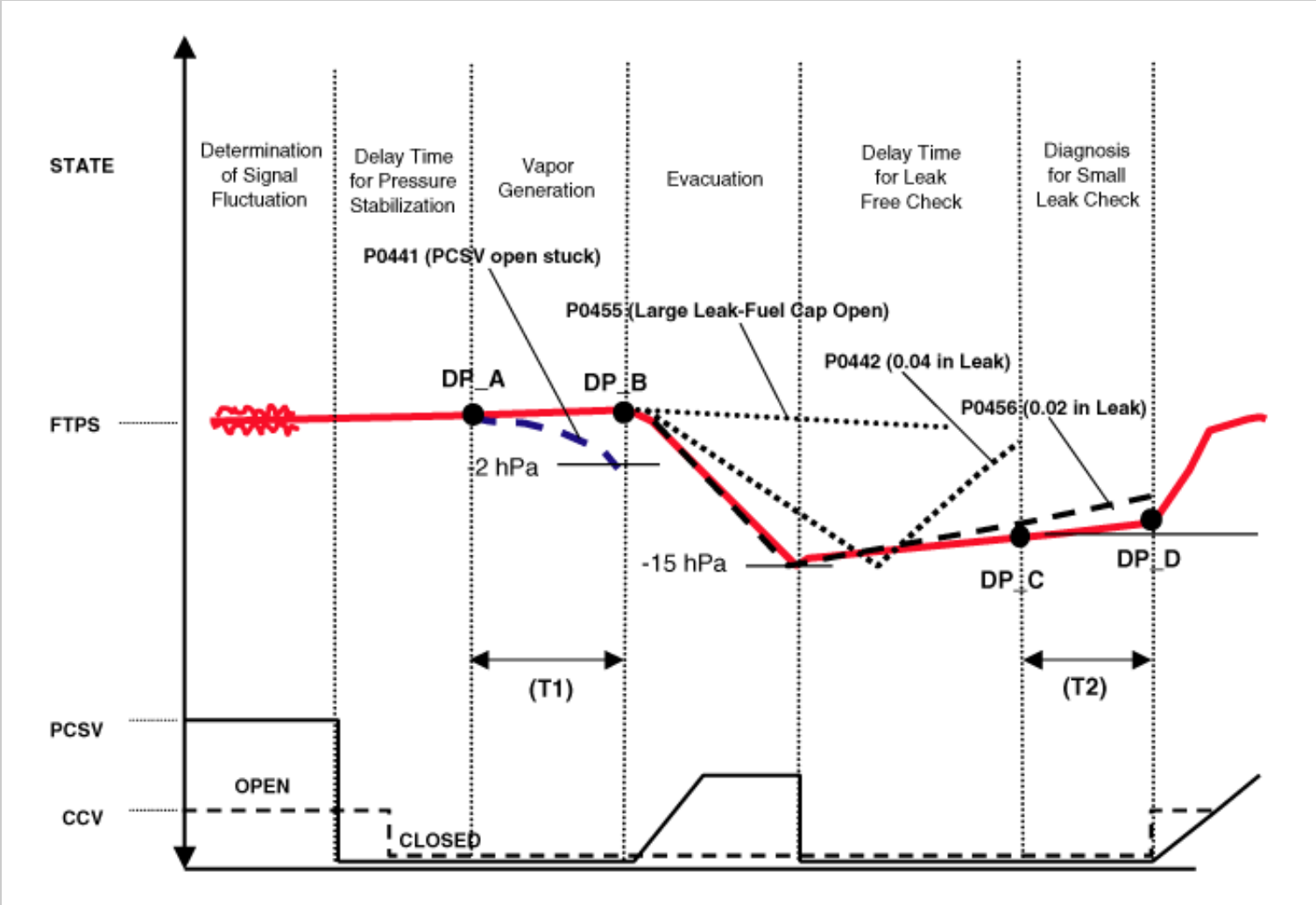
Evacuation

PCSV is opened with a certain ramp for the pressure to reach down to a certain level. If pressure can't be lowered below a threshold, the system is regarded as having an open fuel cap or a large leakage.

Leakage Checking

PCSV is closed and the system waits for a period to get stabilized pressure. During checking period (T2), the system measures the beginning and the end of the system pressure (DP_C, DP_D). The diagnosis value is the pressure difference corrected by natural vapor generation (DP_B - DP_A) rate from the vapor generation checking step.

Evaporative System Monitoring



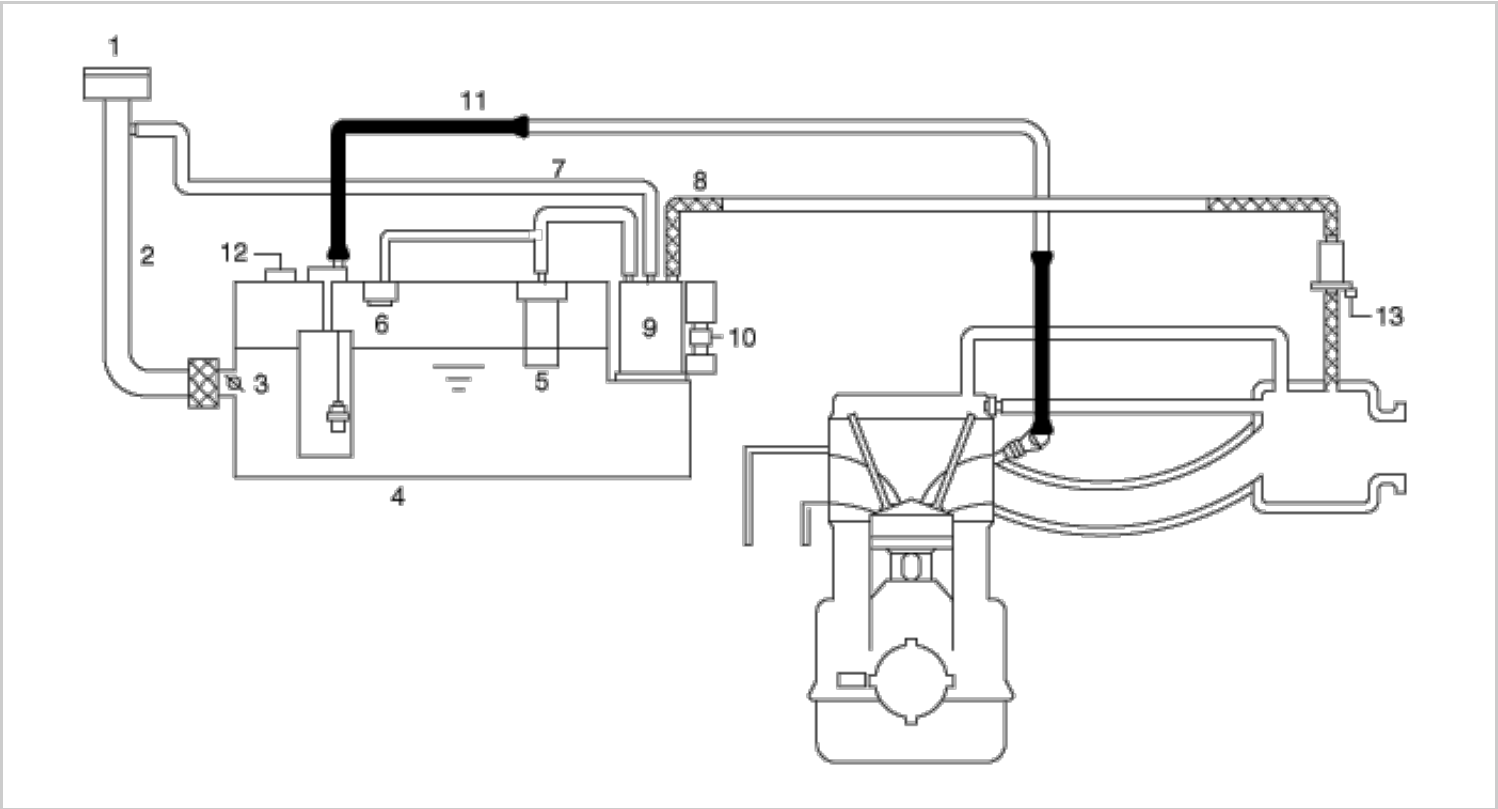
Evaporative and ORVR Emission Control System

This system consists of the following items:

- Fill vent valve
- Fuel shut-off valve
- Fuel cut valve (for roll over)
- Two way valve (pressure/vacuum relief)
- Fuel liquid/vapor separator which is installed beside the filler pipe
- Charcoal canister which is mounted under the rear floor LH side member and protector
- Tubes and miscellaneous connections

While refueling, ambient air is drawn into the filler pipe so as not to emit fuel vapors in the air. The fuel vapor in the tank is then forced to flow into the canister via the fill vent valve. The fuel liquid/vapor separator isolates liquid fuel and passes the pure vapor to the charcoal canister.

While the engine is operating, the trapped vapor in the canister is drawn into the intake manifold and then into the engine combustion chamber. According to this purge process, the charcoal canister is purged and recovers its absorbing capability.



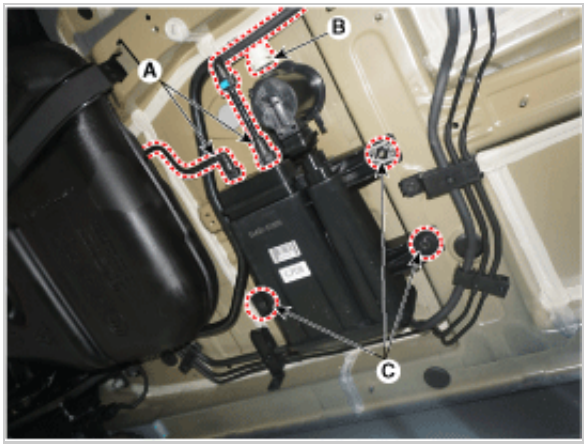
1. Fuel Filler Cap
2. Fuel Filler Pipe
3. Fuel Shut-OFF Valve
4. Fuel Tank
5. ORVR Valve
6. 2-Way & Cut Valve
7. Evaporative Hose
8. Evaporative Hose
9. Canister
10. Canister Close Valve (CCV)
11. Fuel Feed Line
12. Fuel Tank Pressure Sensor (FTPS)
13. Purge Control Solenoid Valve (PCSV)

- Removal

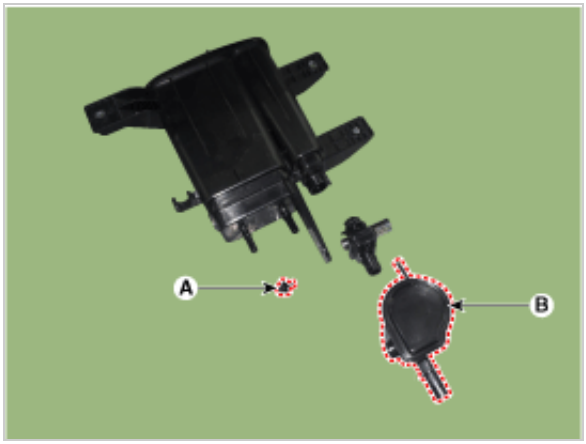
⚠ CAUTION

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

1. Switch "OFF" the ignition and disconnect the negative (-) battery terminal.
2. Disconnect the vent hose quick-connector (B), the vapor hose quick-connector (A) from the canister.
3. Remove the fuel tank air filter assembly after removing the mounting bolts (C).

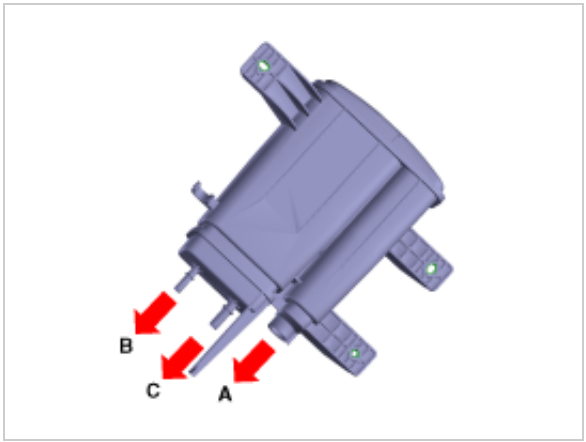


4. Remove the fuel tank air filter mounting bolt (A).
5. Remove the clip, and then separate the fuel tank air filter (B) from the canister after rotating it in the direction of the arrow in the figure.



- Inspection

1. Check for the following items visually.
   – Cracks or leakage of the canister
   – Loose connection, distortion, or damage of the vapor hose/tube



A : Canister ↔ Atmosphere
B : Canister ↔ Fuel Tank (Fuel Pump)
C : Canister ↔ Intake Manifold

- Installation

1. Install in the reverse order of removal.

Emission Control System

- Specification

Item	Specification
Coil Resistance (Ω)	18.5 - 22.5 [20°C (68°F)]

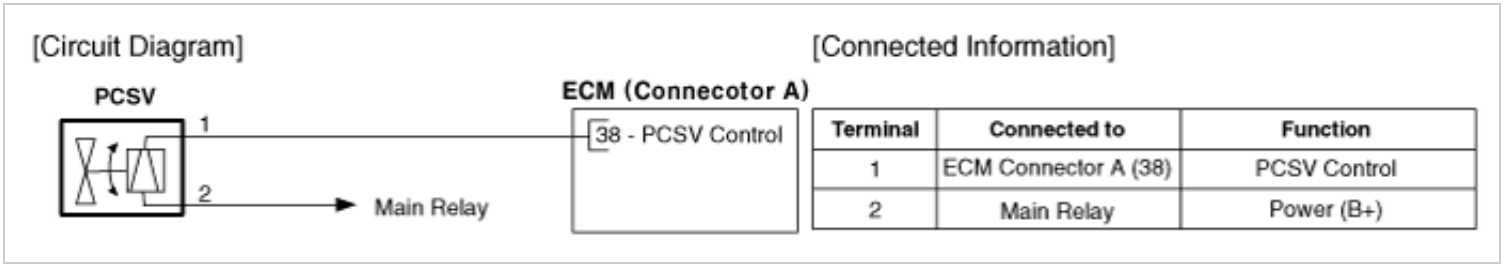
Emission Control System

- Description

Purge Control Solenoid Valve (PCSV) is installed on the surge tank and controls the passage between the canister and the intake manifold. It is a solenoid valve and is open when the ECM grounds the valve control line. When the passage is open (PCSV ON), fuel vapor stored in the canister is transferred to the intake manifold.

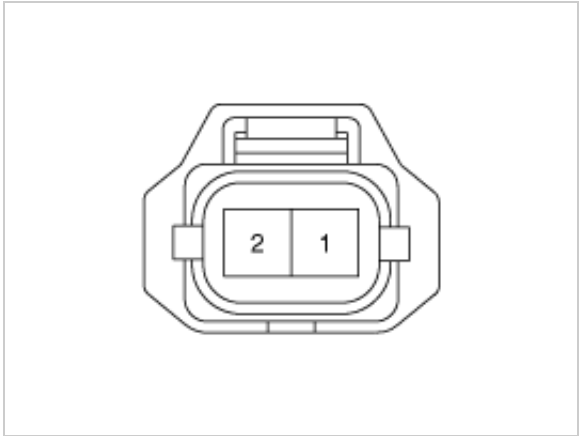
Emission Control System

- Circuit Diagram



Terminal	Connected to	Function
1	ECM Connector A (38)	PCSV Control
2	Main Relay	Power (B+)

Harness Connector



- Inspection

1. Turn the ignition switch OFF.
2. Disconnect the PCSV connector.
3. Measure resistance between the PCSV terminals 1 and 2.
4. Check that the resistance is within the specification.

Specification : Refer to "Specification"

- Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) terminal.
2. Disconnect the purge control solenoid valve connector (A).
3. Disconnect the vapor hoses (B) from the purge control solenoid valve.
4. Remove the valve from the bracket.

- Installation

NOTICE

- Install the component with the specified torques.
- Note that internal damage may occur if the component drops. In this case, inspect it before installation.
- Be sure not to apply oil or lubricant to the end of the hoses when connecting the PCSV hose.
- Be careful of foreign materials not to flow into the valve.

1. To install, reverse the removal procedure.

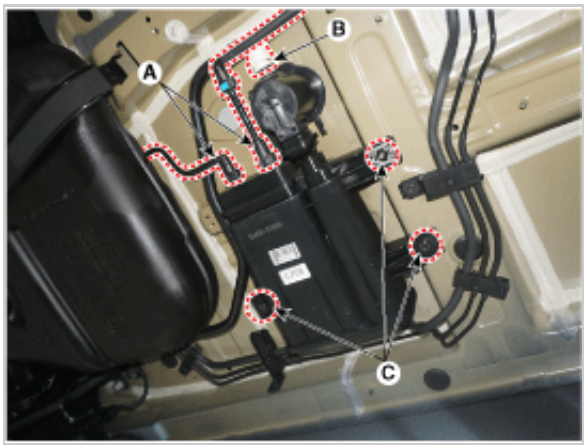
- Removal

⚠ CAUTION

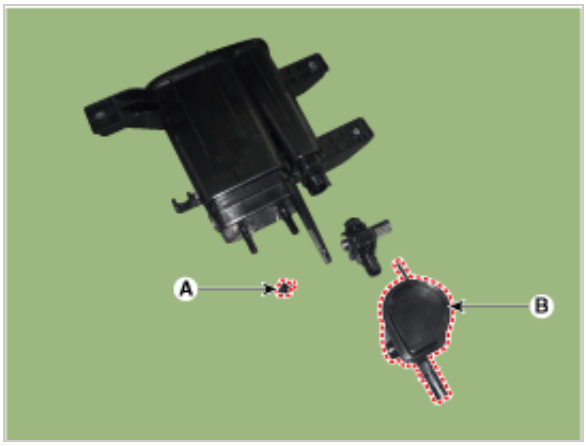
- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

1. Switch "OFF" the ignition and disconnect the negative (-) battery terminal.

2. Disconnect the vent hose quick-connector (B), the vapor hose quick-connector (A) from the canister.
3. Remove the fuel tank air filter assembly after removing the mounting bolts (C).



4. Remove the fuel tank air filter mounting bolt (A).
5. Remove the clip, and then separate the fuel tank air filter (B) from the canister after rotating it in the direction of the arrow in the figure.



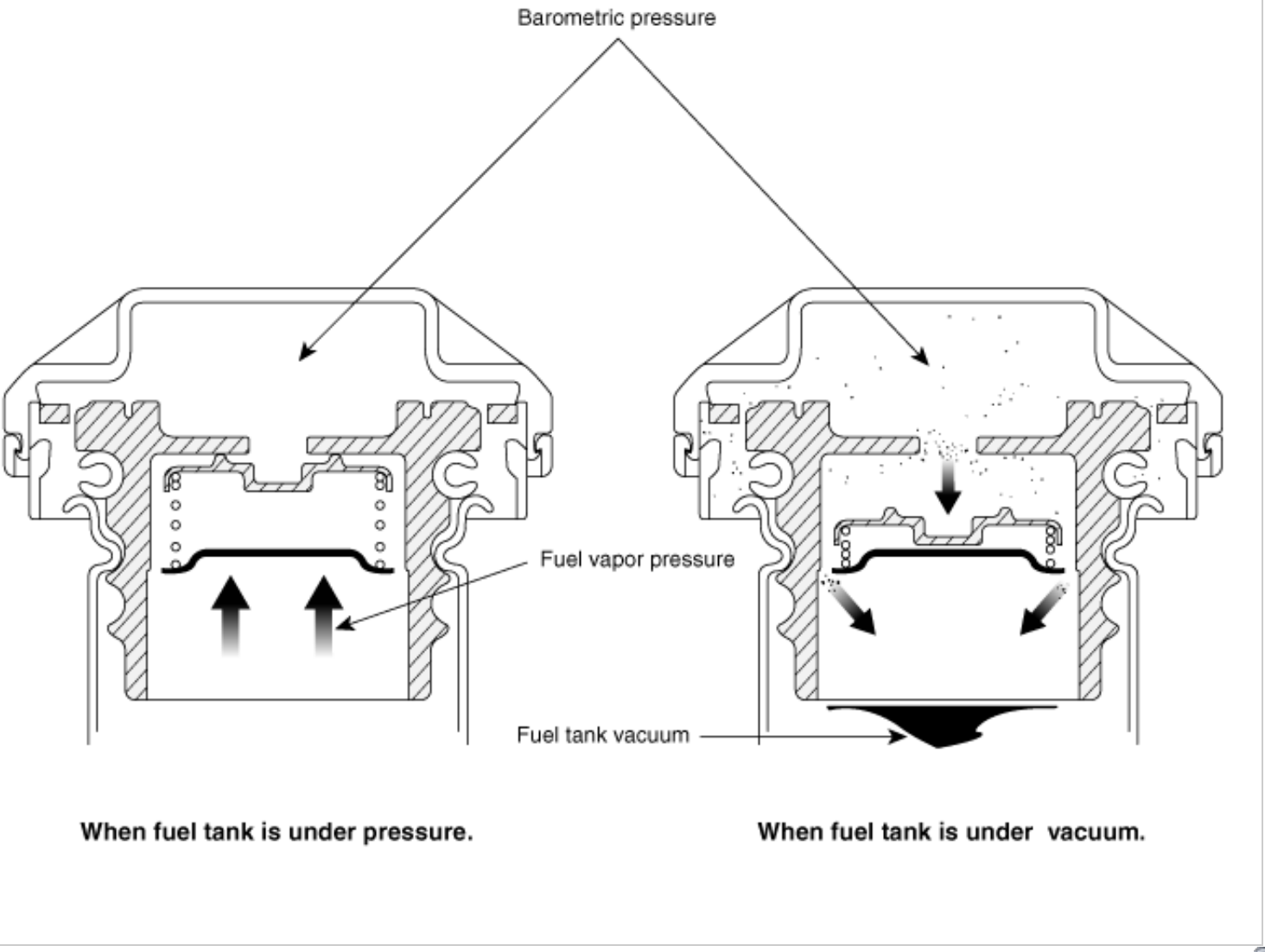
- Installation

1. Install in the reverse order of removal.

Emission Control System

- Description

A ratchet tightening device on the threaded fuel filler cap reduces the chances of incorrect installation, which seals the fuel filler. After the gaskets on the fuel filler cap and the filler neck flange contact each other, the ratchet produces a loud clicking noise indicating that the seal has been set.


Barometric pressure
Fuel vapor pressure
Fuel tank vacuum
When fuel tank is under pressure.
When fuel tank is under vacuum.

Emission Control System

- Description

Exhaust emissions (CO, HC, NOx) are controlled by a combination of engine modifications and the addition of special control components.

Modifications to the combustion chamber, intake manifold, camshaft and ignition system form the basic control system.

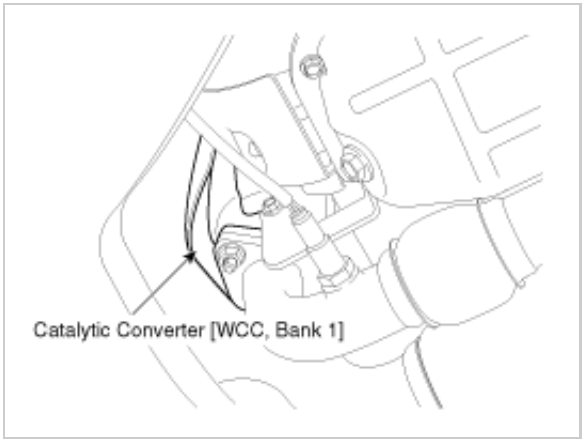
These items have been integrated into a highly effective system which controls exhaust emissions while maintaining good drivability and fuel economy.

Emission Control System

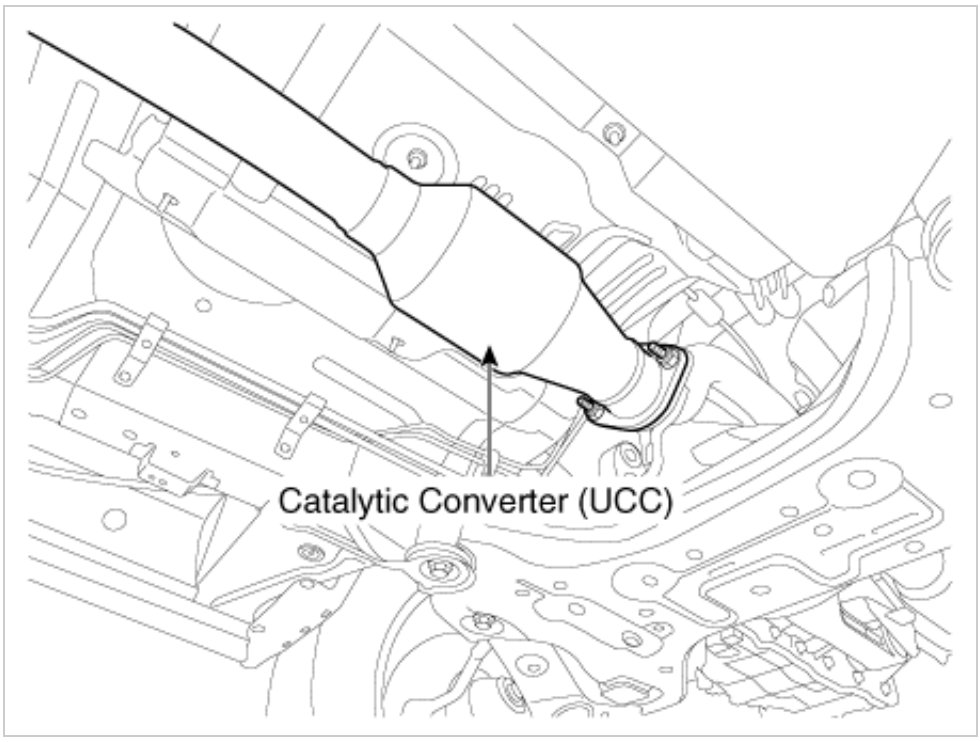
- Description

The catalytic converter of the gasoline engine is a three way catalyst. It oxidizes carbon monoxide and hydrocarbons (HC), and separates oxygen from the oxides of nitrogen (NOx).

Catalytic Converter (WCC)



Catalytic Converter (UCC)



- Removal

Catalytic Converter (WCC)

Refer to Engine Mechanical System - "Exhaust Manifold"

Catalytic Converter (UCC)

Refer to Engine Mechanical System - "Muffler"

- Installation

Catalytic Converter (WCC)

Refer to Engine Mechanical System - "Exhaust Manifold"

Catalytic Converter (UCC)

Refer to Engine Mechanical System - "Muffler"

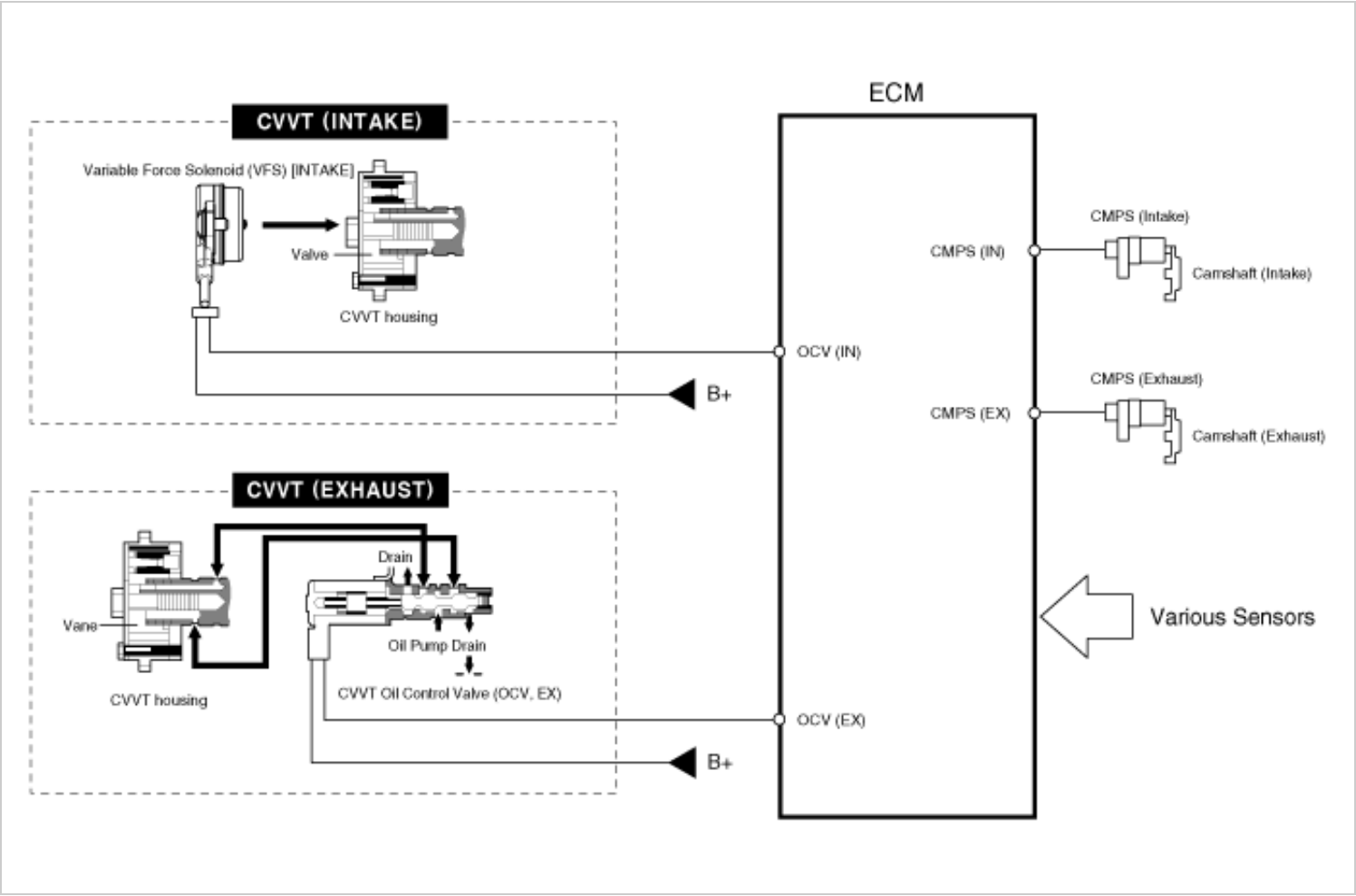
- Description

Continuous Variable Valve Timing (CVVT) system advances or retards the valve timing of the intake and exhaust valve in accordance with the ECM control signal which is calculated by the engine speed and load.

By controlling CVVT, the valve over-lap or under-lap occurs, which makes better fuel economy and reduces exhaust gases (NOx, HC) and improves engine performance through reduction of pumping loss, internal EGR effect, improvement of combustion stability, improvement of volumetric efficiency, and increase of expansion work.

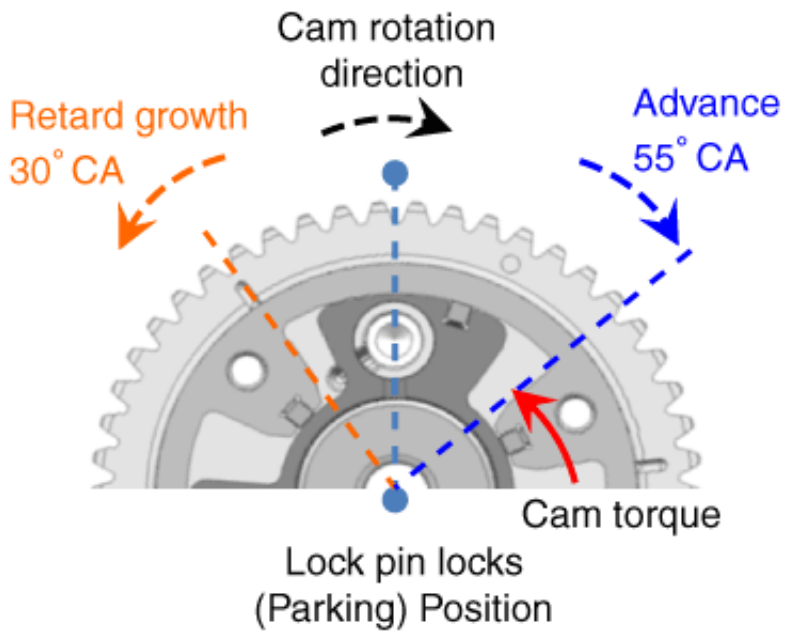
This system consists of the CVVT Oil Control Valve (OCV) which supplies the engine oil to the cam phaser or takes out the engine oil from the cam phaser in accordance with the ECM PWM (Pulse With Modulation) control signal, the CVVT Oil Temperature Sensor (OTS) which measures the engine oil temperature, and the Cam Phaser which changes the cam phase by using the hydraulic force of the engine oil.

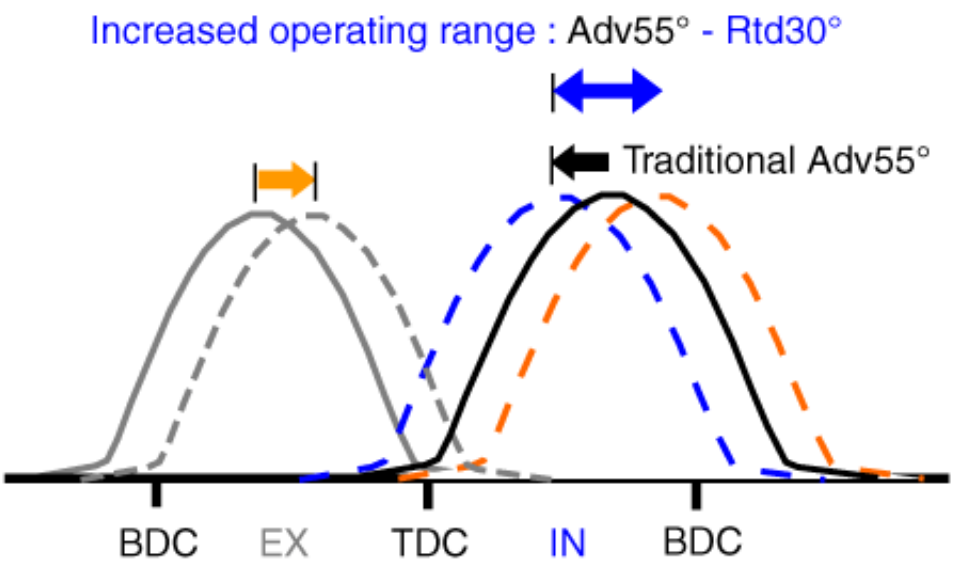
The engine oil which is supplied from the CVVT oil control valve changes the cam phase in the direction (Intake Advance/Exhaust Retard) or opposite direction (Intake Retard/Exhaust Advance) of the engine rotation by rotating the rotor connected with the camshaft inside the cam phaser.



[Intermediate Lock CVVT]

It increases the retarded amount compared to the default state to expand the operating range of the variable valve timing system. The cam phase is fixed mechanically so that it is locked at the middle position.





Default position : Middle

CVVT operates in advanced / retarded directions.

▷Effect

Improves fuel efficiency by approx. 1.7%.

Expands the intake CVVT operating range.
(Increases the retarded amount by up to 30° compared to the default state.)

∇

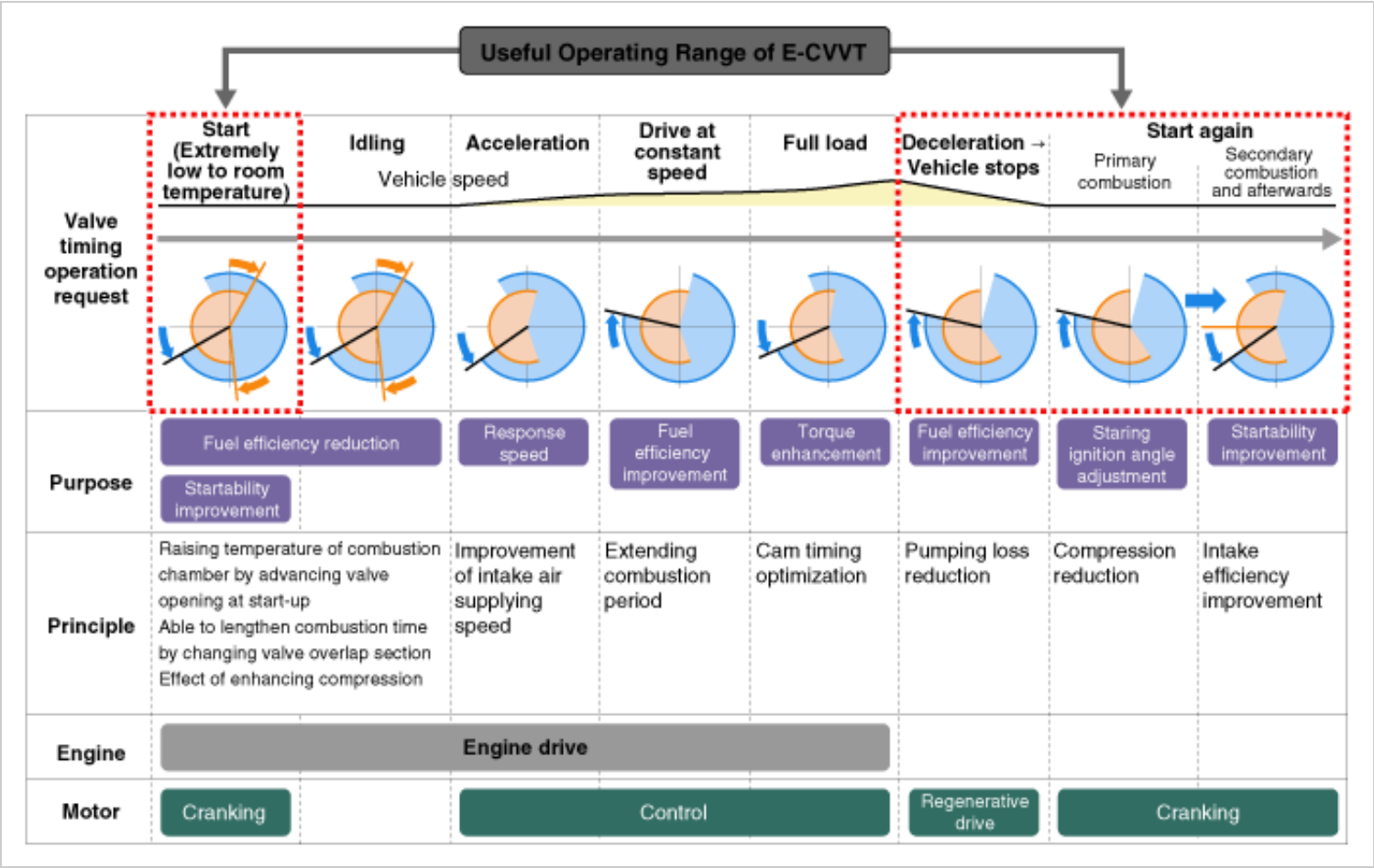
LIVC (Late Intake Valve Close)

∇

1. Improves fuel efficiency by reducing pumping loss.
2. Improves knocking characteristics by reducing compression ratio.

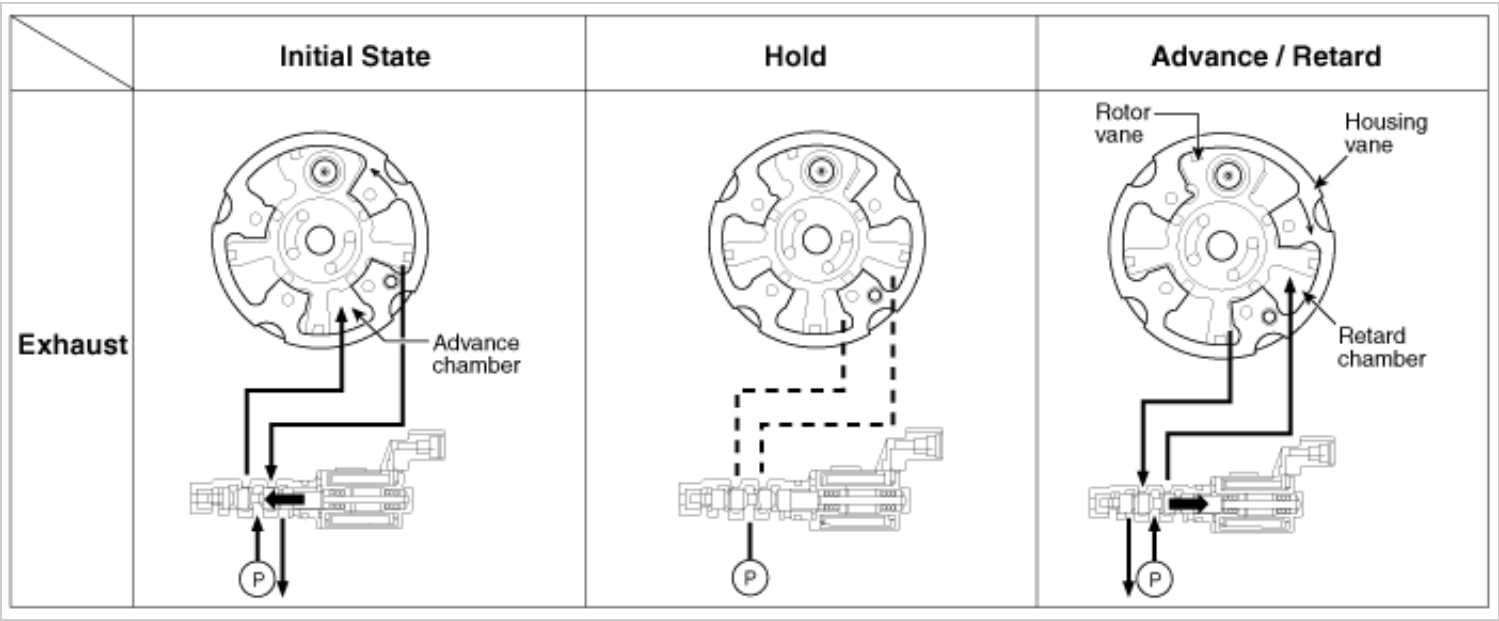
- Operation Principle

[Intake]

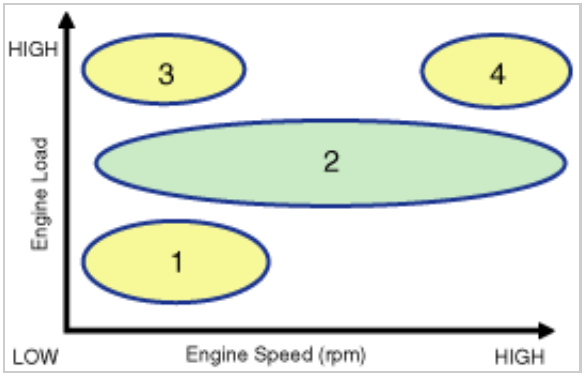


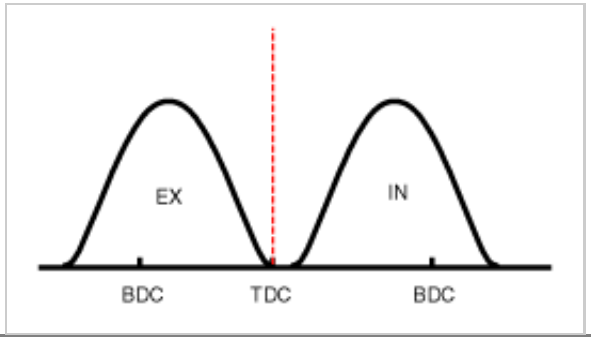
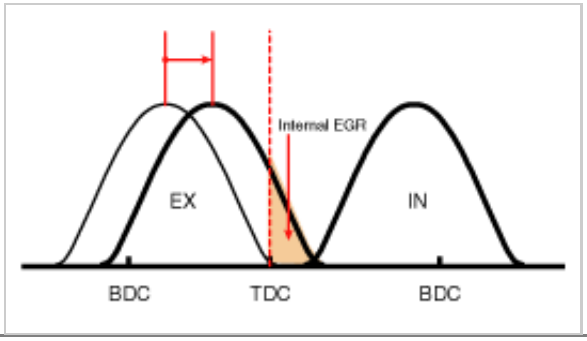
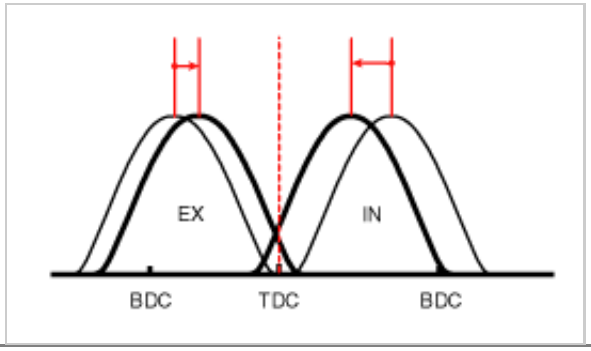
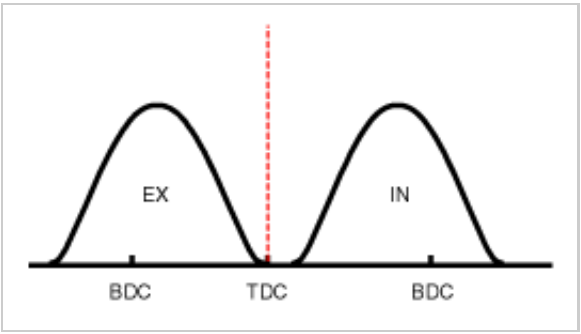
[Exhaust]

The CVVT has the mechanism rotating the rotor vane with hydraulic force generated by the engine oil supplied to the advance or retard chamber in accordance with the CVVT oil control valve control.



[CVVT System Mode]



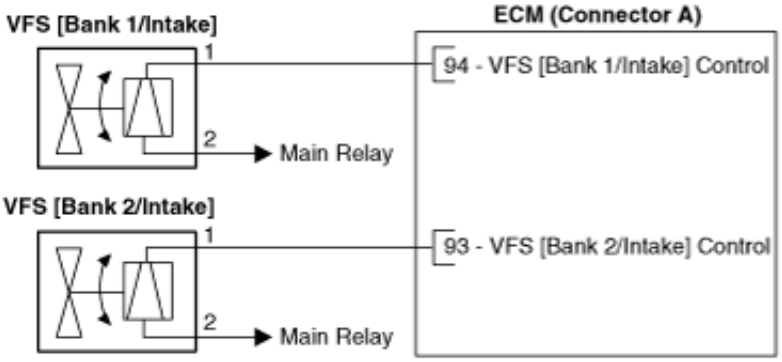
(1) Low Speed / Low Load	(2) Part Load
	
(3) Low Speed / High Load	(4) High Speed / High Load
	

Driving Condition	Exhaust Valve		Intake Valve	
	Valve Timing	Effect	Valve Timing	Effect
(1) Low Speed/Low Load	Completely Advance	* Valve Under-lap * Improvement of combustion stability	Completely Retard	* Valve Under-lap * Improvement of combustion stability
(2) Part Load	Retard	* Increase of expansion work * Reduction of pumping loss * Reduction of HC	Retard	* Reduction of pumping loss
(3) Low Speed/High Load	Retard	* Increase of expansion work	Advance	* Prevention of intake back flow (Improvement of volumetric efficiency)
(4) High Speed/High Load	Advance	* Reduction of pumping loss	Retard	* Improvement of volumetric efficiency

- Circuit Diagram

Variable Force Solenoind (VFS)

[Circuit Diagram]



[Connection Information]

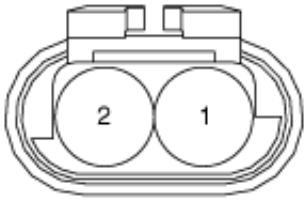
VFS [Bank 1/Intake]

Terminal	Connected	Function
1	ECM Connector A (94)	VFS [Bank 1/Intake] Control
2	Main Relay	Battery Power (B+)

VFS [Bank 2/Intake]

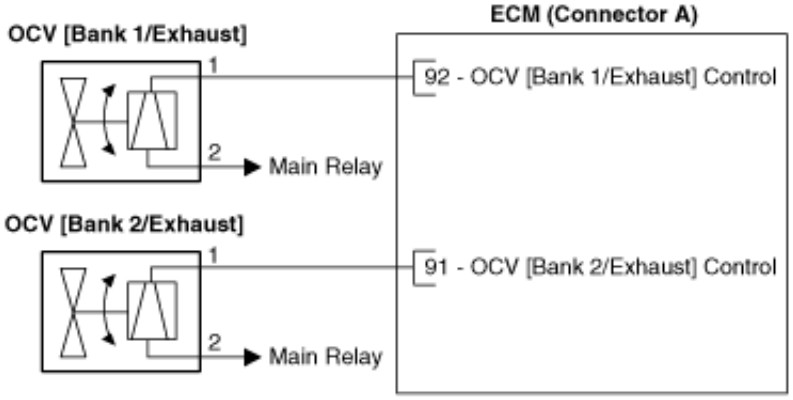
Terminal	Connected	Function
1	ECM Connector A (93)	VFS [Bank 2/Intake] Control
2	Main Relay	Battery Power (B+)

Harness Connector



CVVT Oil Control Valve (OCV)

[Circuit Diagram]



[Connection Information]

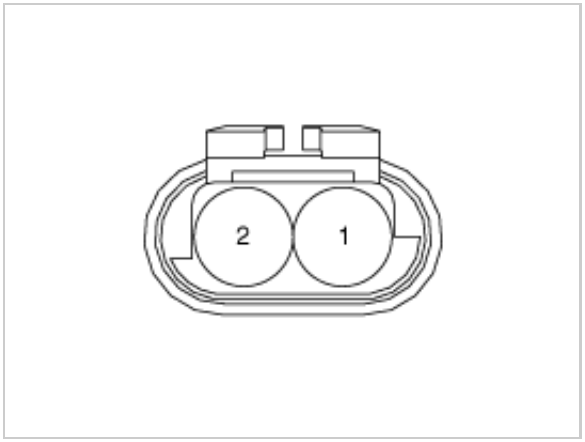
OCV [Bank 1/Exhaust]

Terminal	Connected	Function
1	ECM Connector A (92)	OCV [Bank 1/Exhaust] Control
2	Main Relay	Battery Power (B+)

OCV [Bank 2/Exhaust]

Terminal	Connected	Function
1	ECM Connector A (91)	OCV [Bank 2/Exhaust] Control
2	Main Relay	Battery Power (B+)

Harness Connector



- Inspection

Variable Force Solenoind (VFS)

Refer to Engine Control / Fuel System - "E-CVVT Motor"

CVVT Oil Control Valve (OCV)

Refer to Engine Control / Fuel System - "CVVT Oil Control Valve (OCV)"

- Removal

Variable Force Solenoind (VFS)

Refer to Engine Control / Fuel System - "E-CVVT Motor"

CVVT Oil Control Valve (OCV)

Refer to Engine Control / Fuel System - "CVVT Oil Control Valve (OCV)"

- Installation

Variable Force Solenoind (VFS)

Refer to Engine Control / Fuel System - "E-CVVT Motor"

CVVT Oil Control Valve (OCV)

Refer to Engine Control / Fuel System - "CVVT Oil Control Valve (OCV)"